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BULLETIN

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EDITORIAL.

Moving Pictures in Engineering Education.—The secretary has been asked several times to investigate the question of moving picture films for use in engineering education, and to take up the question of providing some means of interchange of such films. Meanwhile there has been established in Phila-

delphia a Bureau of Commercial Economics, organized for this purpose. An article on "Motography and the Engineer," by A. M. Boggs, assistant director of the bureau, gives information and presents the status of this work.

Membership in Professional Societies.—Election to membership in a national society like the S. P. E. E., is in the nature of an added academic degree. To a man thoroughly established in his profession, it is not so important, but to the young man just entering upon his profession, there is nothing which he can do that will aid him more in his work. No professor would neglect the opportunity of urging the younger men under him to pursue advanced study, similarly, no man in the teaching profession should fail to urge upon the younger men the value and importance of joining the national society that represents his profession.

Salaries of College Teachers.—The Committee on College Administration presented a report at the Minneapolis meeting of the society in 1913 which went, in considerable detail, into the salaries of teachers of engineering schools. The data from which these figures were obtained were signed statements of the deans of the various schools. The variation in salaries was as marked as those indicated in the article by Mr. Wiechardt, the maximum salary ranging up to $7,500. The normal salaries paid at that time for various positions on the teaching staff varied as follows:

Assistant	$500	to	$800
Instructor	1,000	"	1,500
Assistant Professor	1,500	"	2,000
Associate Professor	1,800	"	2,000
Professor	2,000	"	4,000

A given rank does not in general carry with it a given salary, since 78 per cent. of the institutions have no fixed salary for a given position.

Of the ten institutions paying the highest salaries five are privately endowed, one is municipally supported, and four are state universities.

Modern Languages.—The commercial expansion of the United States, the European war, and the general tendencies of engineering education are modifying the modern language requirements in engineering schools. Is German or Spanish to be the more important language for the future engineer? The chief engineer of the largest independent steel company in the world recently said to the editor that they could find no one who could translate their catalogs into the language used in South America. The difficulty arises from the fact that the Spanish taught in engineering colleges is not the kind of Spanish used and spoken in Latin America. Dean Benjamin's article on "Teaching Spanish to the Engineering Student" is a timely contribution to engineering education.

PLANS FOR THE AMES MEETING.

The authorities of the Iowa State College are actively at work preparing for the June meeting of the Society for the Promotion of Engineering Education. The following committees have been established:

General Convention Committee, appointed by President Pearson, with representatives from all the college divisions.

Housing Committee, appointed by the Dean of Engineering to make arrangements for house accommodations for the visitors.

Entertainment Committee, appointed by the Dean of Engineering to arrange the entertainment features of the convention.

Ladies Convention Committee, composed of faculty ladies to make special arrangements for entertainment of the ladies who are guests during the convention.

It has been decided that house arrangements will be made capable of accommodating all of the guests on or immediately adjacent to the college grounds. More detailed announcements as to house accommodations will be made in the January issue of the BULLETIN. It is planned to arrange some special entertainment features which will enable visitors to see some-

thing of the highway engineering and drainage engineering work in progress throughout agricultural Iowa, as well as more usual engineering construction.

More definite announcements as to auto and trolley excursions will probably be made soon.

There are golf links on the college grounds and at the Ames Country Club, reached by hourly interurban cars not far away. College gymnasium, with swimming pool accommodations will be available. It is thought that the large number of tennis courts now under construction will be finished at that time, in addition to those already available.

AMES, 1915.

That the 1915 meeting is to be a good one is indicated by the following members of the Council who have signified their intention of being present.

Anthony, G. C., Dean of the Engineering School, Tufts College.

Baker, I. O., Professor of Civil Engineering, University of Illinois.

Bishop, F. L., Dean of the School of Engineering, University of Pittsburgh.

Crandall, C. L., Professor of Railroad Engineering, Cornell University.

Eddy, H. T., Dean of the Graduate School, University of Minnesota.

Fernald, R. H., Professor of Dynamical Engineering, University of Pennsylvania.

Greene, A. M., Jr., Professor of Mechanical Engineering, Rensselaer Polytechnic Institute.

Hayford, J. F., Director of the College of Engineering, Northwestern University.

Hood, O. P., Chief Mechanical Engineer, U. S. Bureau of Mines.

Howe, C. S., President of the Case School of Applied Science.

Ketchum, M. S., Dean of the College of Engineering, University of Colorado.

Langsdorf, A. S., Dean of the Schools of Engineering and Architecture, Washington University.

Marston, A., Dean of the Division of Engineering, Iowa State College.

Merriman, Mansfield, 1071 Madison Ave., New York, N. Y.

McNair, F. W., President of the Michigan College of Mines.

Norris, H. H., Associate Editor of the *Electric Railway Journal*.

Raymond, W. G., Dean of the College of Applied Science, State University of Iowa.

Riggs, W. M., President of the Clemson A. and M. College of South Carolina.

Spalding, F. P., Professor of Civil Engineering, University of Missouri.

Turneaure, F. E., Dean of the College of Engineering, University of Wisconsin.

Walker, P. F., Dean of the School of Engineering, University of Kansas.

Wiley, W. O., Secretary of John Wiley & Sons.

Woodward, S. M., Professor of Mechanics, State University of Iowa.

There will be published from time to time in the BULLETIN, a list of the men who expect to be at Ames. If you wish to meet these men, meet them at Ames in 1915.

AN ITEM OF INTEREST.

On January 2, The Science Press will begin the publication of a weekly educational journal entitled *School and Society*, which will be edited by Professor J. McK. Cattell. There seems to be need of a journal appearing frequently, covering the whole field of education and its relation to the social order, combining high ethical and scientific standards with free discussion. Its establishment should contribute to the advancement of education as a science and to the adoption of the better methods for which there is evidence.

COMMITTEE ON SECONDARY SCHOOLS.

One of the live problems confronting the engineering schools at the present time is closer coöperation with the secondary schools. This Society has a very able committee under the direction of Professor H. E. Webb.

The following communication is being sent out to a number of men interested in this work, and should receive the prompt attention of all who are interested.

THE EDITOR.

NEWARK, N. J.

Dear Sir: The Society for the Promotion of Engineering Education is desirous of bringing its membership into closer touch with that aspect of secondary education which is exemplified in the technical high schools of the country. In order the better to accomplish this end, a committee on coöperation with secondary schools has been appointed, whose function it is to collect data regarding the work of those schools and to present recommendations looking toward its proper recognition; to the end that students who in these schools are preparing directly for practical work may when they measure up to proper standards be enabled without loss of time to pursue further study of collegiate grade.

The committee requests your early attention to the enclosed form, and begs that you will fill out and return the same as soon as you may find it convenient.

Yours very truly,

L. F. RONDINELLA,
H. T. CLIFTON,
C. M. WIRICK,
H. E. WEBB, Chairman,
Newark, N. J.,
Central High School.

COMMITTEE ON SECONDARY SCHOOLS.

The Committee on Coöperation with Technical High Schools of the Society for the Promotion of Engineering Education, in order to establish a basis for certain of its recommendations at the next annual meeting of the Society desires information as to the present state of the work of this type of school in various parts of the country. It therefore requests your early consideration of the following questions and hopes that you will send replies to the chairman of the committee as soon as it is convenient to do so.

NAME OF SCHOOL.....

1. What courses of study (that is, sequences which a student is to pursue in his high school period) are given in your school? *e. g.*, liberal (general), commercial, technical, classical or manual training.
2. How many years are required for the completion of each course?
3. Is there a distinct course which is "College Preparatory" in character?
4. If so, how does this course differ essentially from other courses of study?
5. If not, is provision made by means of electives for preparation for engineering colleges in the technical course? If so, what electives are necessary?
6. Does your school certify students into any engineering colleges? Please name such colleges.
7. Is your diploma or certificate of graduation in the technical course granted to students who have not pursued courses which lead to college entrance? (Please note that the question is concerned not with equality of grade, but with the inclusion of specified subjects.)
8. Please outline your technical course of study in accordance with the following scheme:

1. Mathematics	.....	.....
2. English	.....	.....
3. Physical Science*	.....	.....
4. Biological Science	.....	.....
5. Mechanical Drawing	.....	.....
6. Free Hand Drawing	.....	.....
7. Shop Work	.....	.....
8. Modern Languages	.....	.....

† A period-year means one period each week for one year. Thus, a course offered five times a week for one year should be credited with five period-years.

* Physics, Chemistry, Astronomy, Physical Geography.

9. Business Practice‡ ....
10. History ....
11. Economics and Civics ....
12. Ancient Languages..... ....

9. Subjects covered in mathematics in the technical course.

10. In case your technical course is in any way governed or restricted by college entrance requirements please indicate any changes you would make in the interest of the course generally, if such restrictions were removed.

11. In case your technical course is wholly independent of college preparation, in what respects do you regard it as better fitted to the needs of your student body than a college preparatory course?

COLLEGE NOTES.

University of Kansas.—The civil, electrical and mechanical engineering students of the senior class made their annual inspection trip during the week of November 23–28. The party was in charge of Dean P. F. Walker and visits were made to various points of interest in and around Chicago, Gary, Ind., Kenosha, Wis., and Keokuk, Iowa.

At the annual meeting of the American Society of Mechanical Engineers, December 1–4, 1914, held in New York City, Dean P. F. Walker presented two papers, one in joint authorship with Mr. W. J. Malcolmson on "Friction Losses in the Universal Joint," and one on the subject of "Physical Laws of Methane Gas."

Yale University.—The following appointments and promotions in the engineering departments of Sheffield Scientific School are effective for the year 1914–15.

Mr. Arthur A. Taggart, for the past three years an instructor in the mining engineering department, has been promoted to assistant professor in that department.

Mr. Robert P. Winton has been appointed instructor in the electrical engineering department. For two years Mr. Winton was with the General Electric Company, and for the past

‡Business Practice to include Bookkeeping, Typewriting and Stenography, Business Organization, etc.

three years he has been engaged in construction work connected with the electrification of the New York, New Haven and Hartford Railroad.

Mr. George A. Stetson has become an instructor in mechanical engineering. Mr. Stetson has been with the B. F. Sturtevant Company for the past two years.

Mr. Donald B. Prentice and Mr. Everett O. Waters, both assistant instructors for the past two years, have been appointed instructors in the mechanical engineering department.

Pennsylvania College, Gettysburg.—A department of mechanical engineering has been organized, with S. R. Wing, of Sibley College, Cornell University, as professor in charge. H. R. Shipherd, of Harvard University, has been appointed professor of English, M. S. Macdonald, of McGill University, professor of economics and political science and P. S. Creager, '14, assistant in physics. C. B. Stover has been advanced from instructor to assistant professor of chemistry and F. G. Troxell from assistant to instructor in mathematics. The increase in enrollment in the engineering courses has been over 50 per cent.

JOHN GALBRAITH.

John Galbraith, dean of the faculty of applied science and engineering, University of Toronto, was born in Montreal September 5, 1846. He received his early education at Port Hope, and in 1863 registered in arts at the University of Toronto. He graduated in 1868, receiving the degree of B.A. He was gold medallist in honor mathematics, and won the Prince of Wales' prize for highest proficiency, established by the late King Edward VII during a visit to Canada.

When the school of practical science was changed in 1906 to the faculty of applied science and engineering of the Uni-

versity of Toronto, Dr. Galbraith was appointed dean of the faculty, which position he ably filled until the time of his death.

In 1907 when the engineering world was startled by the fall of the Quebec bridge, Dr. Galbraith was appointed a member of the commission of three to inquire into the disaster.

Dr. Galbraith was a charter member of the Society for the Promotion of Engineering Education, serving for a number of years as a member of council, and in 1896–97 he was vice-president. He died Wednesday, July 22, 1914, at Go-Home Bay, Ontario.

COMMITTEE ON ELECTRICAL ENGINEERING LABORATORY.

The Committee on Electrical Laboratories requests contributions from members relating to electrical laboratories. It is desired to publish in the BULLETIN short articles covering specific topics which in many cases might be deemed insufficient to be dignified by a formal paper. Brief descriptions, sketches, diagrams showing the arrangement of apparatus, forms of switchboards, devices for lecture room demonstration, statements of modifications of laboratory exercises which have been found useful and methods of instruction which have proved successful, indicate the type of short article which is desired. The aim is to secure descriptions of specific things that are being done, such, for example, as would attract and interest a visitor.

More extended articles will be welcome, but special stress is laid on those which are short.

Contributions may be sent to the chairman or to any member of the committee.

The committee consists of C. F. Scott, C. F. Harding, H. H. Norris, W. I. Slichter, G. B. Thomas.

BOOK REVIEWS.

Introduction to Machine Drawing and Design. By D. A. Low. Longmans, Green and Company, 1914. 40 pp. 30 cents.

This work contains an excellent selection of exercises which if drawn by the student would prepare him for the drawing of original designs. In working out his exercises, the author emphasizes more than is usually the case that the machine part must be made in the shop and that the drawing should be made in such a manner, showing tool clearance and the like, so as to permit the most economic and practical methods of production.

Preliminary Machine Drawing Course. By C. E. HANDY. Longmans, Green and Company, 1914. 242 pp. 75 cents.

This course would fit very well as a preliminary to a course in free sketching, an art which is of great value and convenience to engineers and designers who have cultivated it.

JNO. WEBER.

Plane Trigonometry with Tables. By CLAUDE IRWIN PALMER and CHARLES WILBUR LEIGH, Associate Professors of Mathematics, Armour Institute of Technology. McGraw-Hill Book Co., 1914. x + 156 + 132 pages. $1.50.

This is a conservative and teachable text with an abundance of carefully graded practical problems. The trigonometric functions are defined for any angle, from which those for the acute angle are deduced. Trigonometric equations and inverse functions, for which the students do not usually find use outside the chapter treating of them, are here introduced early and used throughout the book.

F. A. F.

Geological and Topographical Maps. Their Interpretation and Use. By ARTHUR R. DWERRYHOUSE, D.Sc., F.G.S., Lecturer in Geology in the Queens University of Belfast.

In this work the author endeavors, in a clear, concise way,

to explain how the different kinds of maps may be used in the study of the geology of any particular locality.

It is elementary enough, so that the person who has not had a systematic course of instruction in geology will have no trouble understanding the text. However, the correlation of the geology of a country to its topographical features is worked out in such a clear manner that the book should be of great benefit to those interested in this work.

L. C. McC.

Elementary Mathematical Analysis. A text book for first year college students. By CHARLES S. SLICHTER, Professor of Applied Mathematics, University of Wisconsin. McGraw-Hill Book Co., New York, 1914. xiv + 490 pages. 183 figures. $2.50.

It is apparent that students are unable to carry their knowledge of mathematics into its applications demanded by the sciences. While it is not so apparent that they are unable to carry this knowledge into other later applications, it is, perhaps, just as true there, as where they are tested in the results of their mathematical ability by physics or other sciences. This is due in great measure to the methods of instruction, in which students are compelled to spend nearly all their time in acquiring the technique of mathematics, while too little time is given to the application of this technique to sets of conditions expressed in supplied problems. Mathematical text-books have been too much one-sided. They have presented technique but neglected the student's training in a field that is just as important, the analyzing of the elements of a problem and the methods by which these elements and their relations to each other may be expressed in symbols. The reasoning required to do this is just as necessary as that in demonstrating a theorem or deriving a formula. The present book then is a welcome one on our table, for it attempts to do this in a manner much to our liking. Much of the book is grouped about the consideration of the fundamental functions, the power function,

the simple periodic function, and the exponential function, The book will be found to be a rich source of suggestions. However, we wish that the author might have oftener gone outside the field of physics in search of problems, when we remember that this is intended to be a text-book for freshmen in college. The teacher of physics would have less cause for complaint if all of his students had such a preliminary course in mathematics.

F. A. F.

Formulas and Tables for Engineers. By PEIRCE and CARVER. McGraw-Hill Book Company, New York. 1914. Pp. 150 Price —.

A handy, flexible pocket edition of 170 pages, with sections covering the principal mathematical formulas of algebra and calculus with a complete section on mechanics. The sections on mechanics and strength of materials are replete with those working formulas so often required by the engineer, and for which a handy reference is necessary. While the contents of this book are found in the larger and more expensive engineering hand books, this edition is particularly adapted to engineering students, since most of the tables and formulas given are in constant use in the modern engineering school.

H. E. D.

MOTOGRAPHY AND THE ENGINEER.

BY A. M. BOGGS,

Assistant Director, Bureau of Commercial Economics, Philadelphia.

INTRODUCTION.

The following paper was submitted at the request of the editor after considerable correspondence with various members of the Society who are interested in the application of moving pictures in engineering instruction.

There has been established a new department in industrial education under the Bureau of Economics, Inc.

The Bureau is an association of the leading institutions, manufacturers, producers, and transportation lines, to engage in disseminating industrial and vocational information by the graphic method of motography, showing how things in common use are made or produced.

The work of the Bureau is maintained through contributions and annuities. No expense is involved for any institution to whom these lecturers or reels are sent; they are available, however, only when admittance to the public is free.

The Bureau does not accept any remuneration for the exhibition of any reel or slide. The reels and slides are exhibited for industrial and agricultural education.

The corporation is not one for profit and it has no capital stock.

The Bureau displays its reels and slides not only in universities, colleges, technical and agricultural schools, high schools, public institutions, settlement houses, missions, commercial clubs and at trade conventions, but also with powerful projectors, operated from auto trucks, in parks, playgrounds, and other centers for the general public.

THE EDITOR.

The sciences of engineering and motography are to the average mind more opposed to one another than an anode and a

cathode, but in the last analysis there is an intimate and vitally necessary relation between the two poles of electricity. This same intimate relation exists between engineering science and the motion pictures, not only relative to the mechanics of projection but to every type, every phase and every detail both of the theory and of the practice of engineering.

The progress in motography during the past ten years has made, as it were, all things possible. Starting with the crude slap stick comedy, the blood and thunder melodrama in which the heroine escapes half a dozen different varieties of death and of horrors indescribable, in the short space of twenty minutes, the art has been studied by men of science who can now produce on the screen every conceivable object or action. During the past year for example one of the most noted nerve specialists in this country has motographed a series of nerve affections which were hitherto unknown. An eminent roentgenist has shown the alimentary canal of a living person in action. The X-ray motograph camera is being so developed that, in the very near future, we shall be able to see our own heart beating on the screen or a thought furrowing a canal in the gray matter of the brain; it may be that it will be possible to trace the associations as they journey through the intricate convolutions that constitute memory. The motographic possibilities of botany, biology and chemical reactions are as interesting, as startling and as great as those of medicine. How many people have actually seen grass grow from the tiny seed as the innate life pushes aside the protecting shelter of the pod and gradually forces the sword point of the blade through the heavy earth; or how many can describe the movement of the flower as it unfolds its petals and opens its heart to the sunshine? The high speed cameras which our inventive genius has produced have made feasible the motographing of the most minute changes, chemical or structural. The single formula—$NaOH + HCL = NaCl, H_2O$—has hitherto been ascertainable only through calculation and experimentation, yet now it is feasible actually to view this transformation at the

moment of reaction. Of course it is understood that the range finders have but begun the work of surveying the field of the visualization of the remote, the obscure, the invisible, the unknown, the unconceived. The specific rôle which motography assumes to engineering is a medium for instruction, comparison and inductive theorization. That the concept may be tangent to the various departments of the science of engineering let us résumé some concrete instances.

The hydraulic engineer leaves his technical college conversant with theory and with practical experience of a limited amount, limited in duration, extent and variety; he is theoretically familiar with but does not know in actuality the great hydraulic enterprises which are accomplished throughout the world. This limitation is physical; a student can accomplish only so much, can journey only so far in a given time. One may learn verbatim and intelligently a description about a given dam or an irrigation project and yet be totally ignorant of its factual operation. A description is not equal to a visualization! A lesson heard is not comprehended as a lesson seen, a lecture is incomparable to a visature. The young hydraulic engineer knows about the power development at Niagara Falls, but does not comprehend the scope and the details unless he has seen the great power house where the water is deviated above the crest of the Falls through the huge pen stocks dropping to the turbines below, thence escaping by means of subterranean passages; has compared the actual working and power producing value of the revolving field and the revolving armature and has seen the long-distance transmission of power at high voltage, the stepping transformers and the conversion to commercial voltage. If the student is in Berkeley he has probably neither the time nor the money to expend in travel during his scientific course; the student at Boston, on the other hand, is probably unable to see the Keokuk Dam, its actual construction and uses in reclaiming water for navigation, the holding of water for irrigation, the development of power at the waste wier and the

operation of the hydraulic locks. Neither can go, probably, to the Falls of Zambesi to view the conversion of hydraulic power into electrical energy to make commercial calcium carbide.

The delimitative line between the master and the student is experience, not theoretical knowledge. Some of the most interesting, most useful and most astounding of engineering enterprises have been performed by men untaught in the technical schools. Some years ago when a transcontinental railway was being constructed through almost unknown forests a young engineer was ordered to build a bridge across the Little Muddy, the river which, in those days, was as dependable as a woman's decision. He put in his caissons at each bank of the river, had the work well under way when a jolly little spring freshet turned the stream of the Missouri a mile and one twenty-fifth out of its course and left the first abutments of the bridge spanning dry land. The average mind would have been discouraged to discover his bridge of no avail, but the engineer whose theory had been inducted from the school of hard knocks, continued to complete the structure, sinking his caissons and foundations, building the abutments and putting on the superstructure. The work required less time and the construction was better, as no water interfered with the men. But everyone jeered at a bridge over dry land. After the bridge was completed, the engineer took his men one mile and one twenty-fifth west to the west bank of the river, where the Missouri was flowing, chuckling and gurgling over rapids at the fun of outwitting man. The construction gang drove in sheet piling on the far shore; every day the piles were moved toward the bridge and the water forced back into its former channel until one month from the completion of the bridge over dry land, the bridge spanned the Missouri as specified in the original drawing. Who but a "practical man" would have boldly dared to turn the whole course of a river to fit into his plans? Such practice, such experience, can only come, as all know, from actual performance and vision.

The teachers of engineering, in whatever branch they have specialized, are not giving their students the proper background for future work if they omit using motography in connection with their lectures. The young engineer who turned back the waters of the Missouri was only 21 years old, the age when engineers are beginning their studies, but his practical experience and sound judgment, based on vision and comprehension, incited him to do that which his elders declared impractical, impossible. The requisition of motography, as an adjunct to the teaching of engineering science, is a necessary concomitant in modern pedagogy. Every department of the science will profit by the use of visatures. Consider a moment the young man studying civil engineering; he sees on the screen the first surveying of the land, the running of two or three lines, the choice of one of these while the instructor explains the reasons of the choice, the clearing of the ground, the grading and ditching, the first construction of lines, the laying of permanent metal, its bands of steel, its interlocking switches and automatic signals and so on through every detail to the transcontinental limited trains steaming by. He may view and review the pictures until he is thoroughly familiar with every phase, every detail of the work carried on under certain conditions. Then to develop his comparative faculties let another type of instruction be shown, the French line, for instance, across the Sahara, where environment and conditions are totally different, where breaks and piles must be installed to retain the sand, where ties of a certain type must be used and fuel and water transported by pack each day to the end of the line. Again let him be shown the actual building of a railroad over bog land, over and through mountains, over and under rivers and seas. When motography has come into its own, when visatures are used instead of books, and when motion pictures of scientific interest are accessible to the public, there ought to be no condition, no circumstance in the engineering world that cannot be put before the man while he is yet a student.

The agricultural, the mining, the chemical, the electrical,

the structural, the topographical, every engineer ought to be able to comprehend the possibilities and ramifications of the uses of motion pictures in his particular line. For mechanics, every type of engine and machine may be viewed in construction and its uses from the huge generator, grinding and rolling machines of seventy to one hundred and fifty feet in length to the minute action of a tiny sprocket wheel an eighth of an inch in diameter. Microscopic motography is as useful to the engineer as to the bacteriologist and no action is too small, too quick, or too complicated to be portrayed in a large simple and visible picture on a screen. There is as an instance, a film which discloses the making of a watch from the raw material to the finished timepiece. Those tiny wheels, those little screws, almost invisible in a watch as we look at it, are so magnified that they appear as cart wheels on the screen, and the completed watch is evolved through various phases with equal detail apparent to the audience.

One of the difficulties of the moment is, of course, the obtainment of educational films corresponding to the technical text-books in sufficient numbers to supplant the printed page. This obstacle will, of course, be surmounted as soon as the demand is sufficient to warrant the taking of such films. The second difficulty in the use of motography is the law in reference to projection that has placed all sorts of rules and restrictions about a perfectly safe and harmless little celluloid film. A moving picture film is a strip of celluloid 1⅜ in. wide by 5½ to 6/1000 of an in. in thickness on which is printed a continuous series of snapshots, sixteen pictures to a foot of film. The pictures measure each $1 \times \frac{3}{4}$ of an in. and the emulsion is 1/1000 of an in. in thickness. The film, by aid of perforations, four to the inch, or 64 to the ft., passes in front of the condenser lenses at the rate of 1000 photographs a minute. To have a clear white projection at a focal throw of 80 to 125 ft., the usual length of an auditorium, it is necessary to produce a carbon arc of great brilliance. The heat radiating from the intense light is enormous, sufficient to set on fire any inflammable matter if the rays be focused on a spot

for any length of time. The speed with which the film passes over the aperture plate, however, obviates this danger and the films themselves are incased in large seamless, metal magazines. A great number of safety devices are now attached to every standard machine, such as automatic fire shutters, etc., and should, by some chance, a film become ignited, its incasement in covered boxes prevents much damage. Yet the law required that a large booth of specified materials, concrete and iron, brick, asbestos and iron, and so on, be used every time a picture is shown, and a heavy penalty is imposed for infringement of the statute. Celluloid is celluloid, as inflammable in one form as in another, but can any astute gentleman, learned in the law, discover on the statute books any ordinance requiring a man equipped with celluloid collars and cuffs, smoking a pipe, working at a furnace, or cooking his meals over a bonfire, to be inclosed in an asbestos box; or a lady with her celluloid hair combs and hair pins to wear an asbestos hat and a metal veil, for a match will set celluloid afire as quickly and as disastrously as a carbon arc? Who is to be blamed for some of the absurd regulations imposed on motion picture performances is not the question. They must obviously, however, be removed before motography can be used in the school room.

The last difficulty hedging in the general use of visatures has been the lack of an adequate library of films systematized and cataloged similar to the library of books. Several attempts have been made by the General Film Company and others to have a long list of educational films for scholastic use. But the fire regulations and the lack of systematized subject matter militated against their use except as "educational amusement." An organization of recent birth is now gathering together motographs of educational value and working them into a series of studies which are termed visatures. The visatures are designed with three purposes; to disclose to the public the method of production of the things in everyday use; the opening up of opportunity to the unskilled by teaching skill and proficiency in a given trade and finally for the serious students in the higher technical colleges and schools

as a medium for comparative study of constructive methods.

A typical visature which the Bureau of Commercial Economics issues is the silk industry: it consists of a motograph of the life and habits of a silk worm, disclosed through microscopy, a series of tinted slides shows the weaving in many countries and many ages and it ends with the silk weaving in a large American factory. The lecturer has in hand a synopsis of the views which is a scientific dissertation on the art of weaving from which he makes running comment on the pictures.

The equation upon which the Bureau of Commercial Economics works is vision + practice = efficiency, that is, that the eye is nature's medium for the reception of impression, the hand, the medium for accomplishment and together they produce an intelligent workman. The Bureau of Commercial Economics, of Philadelphia, was organized a little over a year ago and is beyond the problematical stage for it is circulating its visatures in six states of the Union through the extension departments of the large universities. But the Bureau does not claim to be a short cut to knowledge, for its founders recognize fully that only by serious study through vision and revision and constant explanation either in the film or by an instructor supplemented by actual practice can results be accomplished. As a medium for industrial, vocational and scientific training the visatures, as they have been and are being collated by this organization, are more logical, more scientific than the mere description found in text-books. Inductive reasoning develops the brain to self-confidence and efficiency. The young man or woman who discovers for himself the casual relations between a generator and an electric light, and the relation of power to heat, and heat to light, will become a self-sufficing economic unit capable of using his rational faculties in other fields as well as in his particular vocation. Induction is the basis of initiative and the Bureau of Commercial Economics is endeavoring by visualization to germinate the initiation that lies dormant in every human being.

ARE TEACHERS IN INSTITUTIONS OF HIGHER LEARNING ADEQUATELY COMPENSATED?

BY PROFESSOR AUGUST JULIUS WIECHARDT, M.E., M.M.E.

As a question this ought to attract very considerable attention; not only from the men interested, but it should also excite the thoughtful consideration of college presidents, members of the various boards of trustees, and educators generally.

The actuating motive in considering this subject is to give wider publicity to certain facts which it is believed very few of the men concerned are fully cognizant of. And also to seek a remedy for the surprisingly bad conditions found to exist.

In order to discuss the question convincingly care has been taken to be as fair and impartial as possible. The general privacy surrounding such questions has necessarily forced the use of approximate data, but many concessions may be made in the result and yet have the general conclusions hold true.

The subject has been approached from three different viewpoints and a final average taken so as to be as certain as possible that the answer to the question shall be at least reasonably correct. These are:—

First: A determination of adequate compensation based upon past experience and present prices.

Second: A determination of compensation based upon the capital invested in a full professor's preparation and equipment for his duties.

Third: A determination of compensation based upon the average salary now received by a full professor in the United States.

First Estimate.

Gross or Net Salary.—By gross salary let us understand the total salary paid by the institution and received by the professor.

By net salary let us understand the balance of the gross salary left, at the end of each year, after deducting *all* of the absolutely necessary expenses demanded by a merely moderate scale of living.

Briefly thus:

Net Salary equals *Gross Salary* minus *Living Expenses.*

A gross salary of $4,000 with a living expense of $3,500 (imposed by the position itself, or by local high prices) is of far less interest to a professor than one paying, say $3,000 with a living expense of only $2,000; the net salary in the second instance being twice as great as in the first. The kernel in the nut is: how many *surplus* dollars will any given position yield?

Net salary is, therefore, all that anyone is particularly interested in, because out of this, one has to provide for all such items as are generally included under the "rainy day" fund. It is further assumed that no one will question the claim that every professor should be paid enough salary to support the average family upon a moderate scale and in accordance with the demands of his position, *plus* a reasonable profit for his labor.

In this light then let us review a few cases which are personally known to the writer.

Twenty-five years ago the gross salary of a certain full professor, in Iowa, was	$1,800
Living expenses for himself and wife were	$ 800
Leaving a *net* salary of	$1,000
Twelve years ago a certain full professor, in Mississippi, received a gross salary of	$2,250
Living expenses for himself and family were	$1,250
Leaving a *net* salary of	$1,000

In this second case living expenses were so much higher that in comparison with the first case, where the gross salary was $1,800, the net salary would have been only $550. That is the net salary was diminishing at the rate of nearly fifty per cent. in thirteen years, but the higher gross salary offset this and left the same net salary as it should.

To-day several professors have informed the writer that out of a gross salary of $1,800 there remains absolutely *no net* salary. And it is personally known to the writer that these professors live upon a quite moderate scale; they do not entertain, and do not enjoy the possession of an automobile, or vehicle of any kind, except in some instances a go-cart, or in others a bicycle upon which latter they roll up the very considerable total of from one to two thousand miles every year between their homes and the institution.

In two known cases the net salary is *minus* and income has to be obtained from outside sources!

It seems a mere truism to point out that these conditions are all wrong. And the injustness of the situation is recognized by the Carnegie Foundation offering to, if we may venture to say it, pauperize professors by pensions! Why pick out professors for such a charity?

Certainly it would be doing greater justice to treat professors as men and adequately compensate them in proportion to the great cost of their educational preparation and in accordance with the real worth of their valuable services.

If we assume that the other two full professors, located in widely separated parts of the country, and who in 1888 and 1901 each received a net salary of $1,000, were not overcompensated, then in both justice and equity the full professor of to-day ought to receive the *same net salary*, although from what follows it will be observed that the $1,000 net salary received twenty-five years ago was certainly worth twice as much as the same sum would be to-day.

The fixed fact is that with living expenses continually going up and professors' salaries no higher than they were

twenty-five years ago the scale of living must assuredly go down. This is a matter of common observation, open to any who are sufficiently interested to take the trouble to investigate.

Eight hundred dollars living expense in 1888 is to twelve hundred and fifty dollars in 1901 as seventeen hundred dollars is in 1913. So that this sum, $1,700, would only fairly represent the actual and necessary living expenses of a full professor and family to-day.

As a matter of fact it is difficult to find any full professors who do not positively need from fifteen hundred to eighteen hundred dollars yearly to maintain themselves and families in any sort of respectable manner, and in accordance with the demands of their positions.

Upon this basis then we might very reasonably conclude that the full professor's salary to-day, in order to be adequate, should certainly not be less than twenty-seven hundred dollars annually.

The Value of a Dollar.—We hear so much about the high cost of living to-day that it is worth while to consider the influence of this in connection with this question of adequate compensation. Local high prices and other special conditions also materially affect the important item of living expenses, but these latter we cannot include at this time, nor does it seem immediately necessary.

To accurately state the value of a dollar to-day as compared with its value, say twenty-five years ago, is an exceedingly big task and one quite outside the object of this discussion.

The best authority immediately available at this writing is a statement published by the United States Bureau of Education upon the authority of the Bureau of Labor. It is well worth thoughtful study and may be found in the Annual Report of the Bureau of Education for 1912, Vol. I, page 29.

This report clearly and reliably shows that during the fifteen years from 1896 to 1911 the retail prices of food had increased *fifty and two tenths per cent!*

Applying this data to the case of the full professor, who

received a very fair gross salary of twenty-two hundred and fifty dollars, twelve years ago in Mississippi, we find that in order for him to be upon the same financial footing to-day he should be receiving a gross salary of *thirty-four hundred dollars!* Or more exactly $3,379.50.

It is not likely that prices have risen uniformly and at the same rate during the last twenty-five years as they did during the fifteen years referred to, but assuming that they have it is interesting to observe that the Iowa professor receiving the fair *net* salary of one thousand dollars in 1888 should now be receiving the gross salary of thirty-three hundred and sixty-six dollars. A most striking agreement!

No one article can be taken fairly as a criterion of the increase in values, or of the depreciation of the dollar; but as a straw pointing in this same direction the writer knows a gentleman who treasured up two small pieces of platinum plate, used by him during his university days for chemical laboratory work, which in 1886 cost one dollar and twenty cents. This platinum he recently gave as a Christmas present to his two small boys, who, upon the advice of a friend, sold the two pieces for four dollars and seventy-seven cents. This result was such a surprise to the father that he is now inclined to the belief that Mr. Bryan made a great mistake in not advocating platinum dollars instead of silver.

It certainly would fit the case under discussion to have a dollar in 1886 now possess the value of *four dollars!*

The average of these estimates is:

Basis of moderate living expenses plus a net salary	$2,700
Basis of increased cost of living during the past twenty-five years	$3,300
Estimated average	$3,000

From this point of view we are therefore led to the opinion that the average full professor's salary should be *three thousand dollars annually!*

Second Estimate.

Cost of a Full Professor's Education.—An interesting, entirely overlooked, and yet exceedingly important fact bearing upon this live subject is the value of the investment represented by the time, labor, and money expended in preparing the average full professor for the proper performance of his duties.

There will naturally be a wide variation in the actual figures for several different men, but on the average it is thought to be conservatively estimated as follows:

The average expenses for an undergraduate student, as estimated from the catalogs of two typical institutions, approximates four to five hundred dollars yearly. This is *exclusive* of room, board, clothing, and similar personal expenses, these items not being considered a proper charge when lost time is included in the final total.

In such institutions as Harvard and Yale the estimated expenses would no doubt exceed the five hundred dollar limit very considerably.

In many institutions there is a growing tendency for the student's work to extend over the summer vacation period and thereby exclude him from remunerative employment at that time. Hence it seems fair to say that the entire four years of undergraduate time is practically non-productive as to income earning, and such has been the assumption.

It is taken for granted that a candidate for a full professorship would have to obtain the master's degree. And in the case of a professor giving instruction in industrial subjects he would have to spend at least a sixth year acquiring the valuable technical information which is so much appreciated by technical students. Other professors would likewise have to spend a sixth year in acquiring their doctor's degree.

To all of this many professors actually add a further training in their vacation periods during the ten years leading up to the full professorship. And furthermore, the institutions

seek to enforce this as a necessity by methods of selection through competition. All of which is as it should be.

This very necessary broadening out and polish is acquired in various ways; some of it by foreign travel, some by membership in professional societies, or by both; but always at the expense of the individual for both time and money.

It is difficult to fairly estimate the average for this, but surely it would approximate at least one hundred and fifty to two hundred dollars annually, considering both time and money expended.

Tabulating these estimates we have:

THE COST OF TRAINING A FULL PROFESSOR.

Four years of undergraduate expenses, excluding board, room, clothing and similar personal expenses @ $400 to $500 annually	$1,600	$2,000
Four years' lost time @ $800 to $1,000	$3,200	$4,000
One year's expenses for the master's degree	$500	$750
One year's lost time acquiring the master's degree	$1,000	$1,200
One year's expense for special technical work, or for the doctor's degree	$ 600	$ 750
One year's lost time due to the last item	$1,200	$1,500
Ten years' time and expense for traveling, society membership, library acquisitions, etc., @ $150 to $200	$1,500	$2,000
Estimated totals	$9,600	$12,200

The average of these totals is $10,900, or conservatively in round numbers say *ten thousand dollars!*

If any one doubts this estimate let him consider it from the viewpoint of undertaking the responsibility of starting with any young man and training him for the successful performance of duties such as fall to the lot of the full professor.

This investment of ten thousand dollars is purely a business investment and should be treated in precisely the same way as any other capital invested in business. What is the result of such a consideration?

The ordinary business man earns from twenty to as much as fifty per cent. gross upon his invested capital, these figures

being the statement of a wholesale grocer recently made to the writer.

Swift & Company of Chicago are reported as expecting to pay fifteen per cent. *net* upon their capital stock of many millions.

It is common knowledge in financial circles that five per cent. bank stock frequently sells for one thousand dollars a share; as a matter of fact this is the same as paying fifty per cent. upon the original par value of one hundred dollars a share! And so it is for many, aye too many, enterprises.

Hence a ten per cent. profit upon the investment of ten thousand dollars necessary for training a full professor should surely be not only moderate, but even perhaps unfairly low.

If the professor dies his investment goes with him; if the businessman dies his investment remains; therefore it is merely conservatively necessary for each full professor to carry ten thousand dollars worth of life insurance as a protection against this certain loss. Otherwise he would have to start a sinking fund to cover the loss of the invested capital.

This line of reasoning was applied recently to the case of a full professor, a friend of the writer, receiving only eighteen hundred dollars salary.

Annual salary for a full professor		$1,800
Interest on $10,000 educational investment @ 10 per cent.	$1,000	
Life insurance, or Sinking fund @ $20 per $1,000....	200	$1,200
For services rendered this leaves a *net balance of only*		$600

"Why," he exclaimed, "I could have earned twice that sum annually without ever making any such investment!" And no doubt he could, since many workmen exceed that amount. Even a street car conductor earns $900 to $1,000 annually!

On the basis then of this ten thousand dollar investment what might properly be considered adequate compensation?

In tabulated form the reply is:

Moderate and actual living expenses per annum	$1,700
Interest and sinking fund on $10,000 @ a total of 12 per cent.	$1,200
Net salary, basis of Iowa and Mississippi professors	$1,000
Estimated total	$3,900

This line of thought, therefore, leads to the conclusion that a full professor's salary should be *thirty-nine hundred dollars annually.*

THIRD ESTIMATE.

The Present Average Salary.—Through the courtesy of the United States Bureau of Education the writer has before him a carefully prepared statement of the salaries paid by state-aided institutions of higher education in this country, to their presidents, deans, full professors, associate, assistant and adjunct professors; and to their instructors.

A detailed study of all these valuable data would be very instructive, but for the purposes of this investigation we shall confine ourselves chiefly to the salaries of full professors. It being assumed that they are sufficiently typical of the others to be taken as fairly representative.

The data referred to give the maximum and minimum salaries paid to each class of persons by the institution reporting. Of these we shall only consider the maximum salary paid to any one class of men.

A professor conveniently located and near to his work is a much more efficient worker for the institution than one not so situated, but notwithstanding this business principle, only about one quarter of the institutions reporting furnish houses to their professors, and only about one eighth in sufficient numbers. Since it is not clear which class of professor receives the use of a house in addition to his salary their value has not been estimated nor added to the cash part of the salary, tending thereby to reduce the average of the maximum salaries used.

The following cut is a graphical presentation of the maximum salaries received by full professors and was carefully

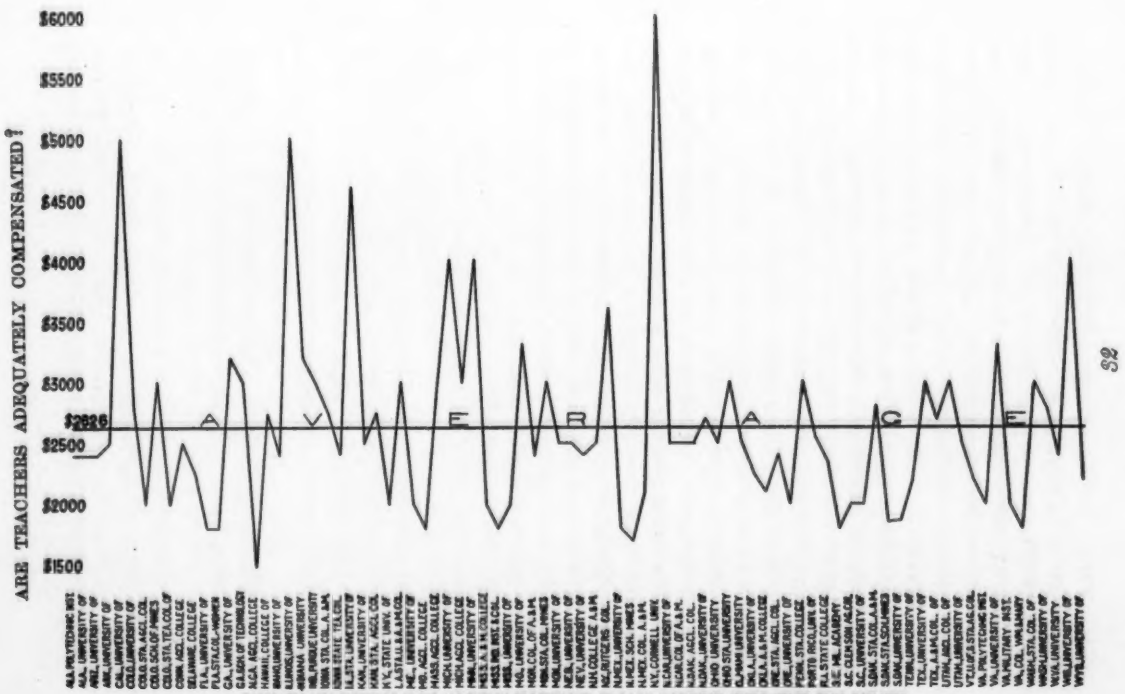
prepared from the data published by the United States Bureau of Education.

A casual glance at the accompanying graph instantly impresses one with the great irregularity of the lines (*i. e.*, salaries). The range is from fifteen hundred dollars without a house to six thousand, possibly with one. *Not all men occupying any given position are equal.* Neither are *all men occupying any given position greatly unequal!*

Here then are two full professors one of whom receives *four* times the compensation of the other. One might infer that one does *four* times the work of the other. The probability is, though, that the $1,500 professor does the more real work strictly for the institution.

It is conceivable that the duties of one of two positions, or even the services of one of two professors, might be worth fifty per cent. more than the other; or in the most extreme instance possibly one hundred per cent. more; but a difference of *four hundred per cent.*, based on merit only, is utterly unbelievable. If this difference is legitimate among institutions why is it that we find so little of it among men of the same rank in private institutions? The greatest range among men of the same rank in the same institution is perhaps not more than ten or fifteen per cent. In the opinion of the writer it is an error to say that so far shalt thy salary go and no further. Salaries should be carefully based upon training and experience, or what amounts to the same thing upon *merit.*

It will be observed that only four of the salaries rise above the four thousand dollar line and no criticism is offered upon this point as local or other unknown conditions may control the matter, or even a year of twelve months may be the cause. But attention is drawn to the predominance of low salaries and it is believed that this is the real reason for the apparently erratic range. Indeed many of the points below the line, representing the average, correspond to salaries so small as to positively preclude either net salary or interest upon the capital invested in educational preparation.



BASED UPON DATA FURNISHED TO THE U.S. BUREAU OF EDUCATION BY EACH INSTITUTION NAMED-HOUSE RENT EXCLUDED.

We are constrained to believe in the correctness of the principle laid down by a certain professor who said: "A man who is not getting ahead is falling behind!"

As great a discrepancy exists among the other classes of men for whom salaries are reported, as is evident from the following table:

It appears from this showing that no rationally uniform basis is now in use for compensating either a full professor or any of the men occupying the above positions.

	Maximum.	Minimum.	Percentage of the Maximum Over the Minimum.
Presidents	$15,000	$2,400	625%
Deans (Maximum)	6,000	1,850	324%
Full professors (Maximum)	6,000	1,500	400%
Associate professors (Maximum)	3,000	1,400	214%
Assistant professors (Maximum)	3,000	1,000	300%
Adjunct professors (Maximum)	2.000	1,000	200%
Instructors (Maximum)	2,000	600	333%

To be perfectly fair the average salary for a full professor in the United States should be made up by considering the number of recipients rather than the number of institutions reporting; however these data were not available and consequently the average was made from the maximum salary paid to a full professor by each institution. It is shown to be twenty-six hundred and twenty-six dollars. Or since we are necessarily dealing with approximate figures let us call it in round numbers *twenty-seven hundred dollars annually.*

It is not conceded, however,that the average salary is necessarily a fair or just measure, because it contains so many salaries which are actually less than is necessary for living upon any decent sort of scale under the prevailing high prices of practically everything requisite for even a moderate scale of existence.

As a matter of interest and of information the following data are inserted. It is made up from the list of maximum salaries paid to men in the different positions by each institution.

AVERAGE OF MAXIMUM SALARIES PAID BY INSTITUTIONS OF HIGHER EDUCATION IN THE UNITED STATES.

Presidents	$5,207
Deans	$3,260
Full professors	$2,626
Associate professors	$1,913
Assistant professors	$1,644
Adjunct professors	$1,442
Instructors	$1,327

The writer knows of an institution which had this experience in recently seeking a competent instructor in mechanic arts:

Of nine *non-graduate*, but experienced applicants the average salary expected was $1,680.

This is about equivalent to the salary paid to an assistant professor.

Of seven *graduates*, of little or no experience, the average salary expected was $1,320.

These interesting figures, coming as they do fresh from the industrial world, eloquently tell their own story.

SUMMARY.

The salary of a full professor might very reasonably be determined by an average of the three preceding methods of treatment, thus:

By the first analysis it should approximate	$3,000
By the second analysis it should approximate	$3,900
By the third analysis it should approximate	$2,700
Total of the three methods	$9,600
Average of the three methods	$3,200

It would certainly seem that any thoughtful person, and especially any one interested in the success of higher education, would be irresistibly forced to the conclusion that men engaged in such work are *not* adequately compensated, and that *the gross salary for a full professor should not be less than thirty-two hundred dollars annually.*

There may be room for differences of opinion as to some of the foregoing figures, but the conclusions reached and the principles involved in reaching them are undoubtedly correct. And furthermore it is confidently believed that they will receive very general acceptance.

Granted then that men engaged in educational work are inadequately compensated what is to be done about it? On the one hand the institutions are chronically "hard up," indeed strange to say many are struggling for existence!

On the other hand the class of men referred to are in even worse plight and it is unquestionably unjust, as well as unreasonable, to expect them to continue to give their best efforts; their rights to accumulate an old age and rainy day fund; and also surrender the eminently just interest upon their educational investment, even to such a splendid cause without adequate returns.

We are aware that other occupations may be sought and judging by the increasing difficulty of obtaining and holding really well trained men many must be doing this.

Neither are we unmindful of the fact that a man, who has in good faith thoroughly educated and prepared himself for this service, cannot easily change his occupation; nor can he afford to make expensive changes of residence, even when offered a small increase in salary.

Counting the time that a professor works as averaging three quarters of the year, his salary *for the time employed* is perhaps not unreasonably low. Thus the average of $2,626 now paid in the United States for the nine months scholastic year would become $3,500 for the twelve months if continually employed at the same monthly rate.

This thought indicates the advisability of running institutions of higher education the entire year; to which there would doubtless arise much opposition, largely based upon selfishness however. Where in the industrial or commercial world can one find such an example of the inefficient, nay even wasteful, use of plant and equipment as exists in the present-day prac-

tice of these institutions? If a full year is not desirable why not cut it to six months?

A twelve months scholastic year would not only increase the efficiency of the institutions, but most important of all would reduce the students' time and expense just twenty-five per cent. This would react to attract a larger attendance, thereby reducing the cost per capita of output and at no greater monthly cost for operation.

However it is not the intention of this article to discuss remedies; that will necessarily have to originate with and be developed by the men concerned.

Publicity and sincere general discussion coupled with the interchange of data, aided by coöperative action, will adjust the matter far better than any such academic discussion as this can.

To render this effective several plans have been suggested, two of which appear to be feasible enough to mention. One is the formation of a club to discuss this and possibly other matters of live interest to professors. The presidents of these institutions have already led the way in this direction by organizing the National Association of State Universities and have already promulgated the excellent idea of a "standard university." So likewise let the professors "get together" in an effort to establish a *standard salary*. Other examples for this are not wanting, for everywhere about us organized effort does, and continues to, replace individual effort.

The second idea is for the professors to publish a magazine as the vehicle for this publicity, discussion, and interchange of thought. It is perhaps the better idea of the two, though the one should certainly accompany the other.

SPANISH FOR ENGINEERING STUDENTS.

BY C. H. BENJAMIN,

Dean of the School of Engineering, Purdue University.

German, French and Spanish are the languages quite generally taught in engineering colleges and they apparently rank in the order named as regards importance. An inquiry sent out by Professor A. S. Wright of Case School in 1908* developed the following opinions: (*a*) An overwhelming majority in favor of teaching at least one foreign language to engineering students. (*b*) An almost equal majority in favor of German as the most important language of the three above mentioned, 61 out of 88 voting in its favor.

It is important to notice that the men responding to this query were engineers and not educators.

It is not the purpose of the present paper to discuss the general subject of language teaching but rather, assuming the desirability of at least one foreign language, to consider the advantages of Spanish as a substitute for French or German.

As has been pointed out by various educators, the purpose of foreign language study is threefold:

(*a*) *Cultural.*—To insure training in language forms and familiarity with national literatures.

(*b*) *Professional.*—Acquisition of the ability to read foreign technical publications and to use foreign handbooks.

(*c*) *Commercial.*—To obtain a command of the language for writing and speaking in business transactions.

German is urged by German teachers for the first reason and by practicing engineers for the second.

It is doubtful to what extent college graduates realize either of these purposes. Probably but few appreciate the literature and even fewer can read the language well enough to make much use of German text-books or works of reference.

* *Proceedings S. P. E. E.*, Vol. XVI.

This deficiency is due to imperfect preparation in the high school and insufficient time in the college.

The same arguments can be urged for the study of French, but not to the same degree. Probably as much may be said for French literature as for German; this can be but a matter of opinion.

The professional use of German is probably more extended than that of French. Even this depends upon the use to be made of the language. Undoubtedly the chemist and the physicist can better find what they need in German publications.

On the other hand, the mathematician and the astronomer are quite as likely to find French the more useful, while the civil engineer and the architect can not afford to neglect the study of the latter language.

As a cultural study, nothing has ever been found to equal Latin and Greek. For professional purposes, German and French are most valuable. We have remaining the third purpose of language study, that of commercial use. Spanish at the present time is more important commercially than German or French. Our trade with European countries is for the most part well established and not dependent on linguistic considerations, while American engineers find little to attract them on the continent of Europe.

The business relations which are new and which need development are those with Mexico and Central and South America.

The literature of Spain, be it historical or technical, is inconsiderable compared with that of France or Germany. The language drill in learning Spanish is comparable to that of French.

It has seemed desirable in preparing this paper to ascertain what is the prevailing practice as regards the teaching of Spanish in our technical schools and what is the prevailing opinion as to the best policy in the future. These two items are not necessarily identical.

Information received from the U. S. Commissioner of Edu-

cation shows fifteen high schools in 1911 where Spanish was taught as an optional course of from one to four years. Four of these were in California, five in other western states and the remainder in the central or eastern states. This list was incomplete and only serves to indicate a tendency.

In Indiana this present year (1914) two cities have Spanish in the high school curriculum and four others have the matter under consideration.

A similar list of colleges (also marked incomplete) includes over one hundred institutions of college grade where Spanish is taught. New York and Ohio lead with nine each, Massachusetts has five and California, Texas and Indiana each have four.

Approximately half of these are colleges or universities where engineering is taught. It is evident that practically all technical institutions give some instruction in this language. Bulletin of the U. S. Bureau of Education No. 3 for 1913 by Charles Handschin reports 171 colleges out of a list of 340 as teaching Spanish, or about one half. The author says that most of the progress in teaching this language has been made since the Spanish-American war.

Letters have been written to prominent teachers of engineering in twenty-six technical institutions of this country and replies have been received from all. These letters were addressed for the most part to Deans of Engineering and in two or three instances to executives or to members of the faculty with whom the writer had personal acquaintance. The following questions were asked in each letter:

1. In your opinion is it wise at the present time to offer Spanish as a substitute for French or German in the curriculum for engineering students?

2. If so, would this apply more particularly to civil and chemical engineers, or would you make it general?

3. Is there sufficient demand, present or prospective, for Spanish writing and speaking graduates to make this plan really worth while?

Letters were also sent to the registrars of the several insti-

tutions asking as to the proportion of engineering graduates at present employed in countries where Spanish is the prevailing language. Only about one half of the number written to responded but enough to show the general situation.

Information as to the present status of Spanish in these institutions was derived from the letters and from current catalogs.

It is to be noted, however, that the answers to the queries 1, 2 and 3 represent the personal opinions of the writers quoted and may or may not correspond to the present practice.

In the subjoined table, the numbers 1 to 7 may be classed as eastern, numbers 8 to 19 as central and numbers 20 to 26 as western institutions. Purdue University is not included

ANSWERS TO QUESTIONNAIRE.

Institution.	Answer.			Per Cent.	Present Status.	
	1	2	3		No. Year.	Remarks.
1. Mass. Inst.	Yes	All	....	1.3	One	Elective.
2. Worcester	Yes	All	Yes	?	None	Not taught.
3. Columbia	No	...	....	4	One	Senior elective.
4. Cornell	Yes	All	....	2	None	No language taught.
5. Univ. of Pa.	Yes	All	Yes	.....	Three	Elective.
6. Pa. State	?	...	....	.....	Two	Spec. elective.
7. Lehigh	No	...	No	6	Two	Soph. Jun. elective.
8. Case School	No	...	....	1	One	Senior elective.
9. Ohio State	No	...	....	.....	Two	Gen. option.
10. Ky. State	Yes	...	....	2	.....	Language elective.
11. Univ. of Mo.	No	...	....	1	One	Gen. option.
12. Wash. Univ.	No	...	....	.....	None	Not taught.
13. Iowa State	Yes	All	....	1.7	.....	Language elective.
14. Univ. of Iowa	?	All	?	.....	None	Not taught.
15. Illinois	No	...	....	2	One	Gen. option.
16. Univ. of Mich.	Yes	All	Yes	2	.....	.....
17. Mich. State	Yes	All	Yes	1	None	.....
18. Wisconsin	Yes	...	....	2	One	Gen. option.
19. Minnesota	No	...	....	.....	One	Gen. option.
20. Nebraska	Yes	All	Yes	6	One	Gen. option.
21. Univ. of Kan.	Yes	?	....	13	One	Gen. option.
22. Univ. of Col.	Yes	All	....	.....	One	Gen. option.
23. Univ. of Tex.	Yes	?	Yes	.....	.....	.....
24. Texas State	Yes	All	Yes	?	None	No language.
25. California	Yes	?	Yes	7	.....	Spec. elective.
26. Stanford	?	...	....	.....	One	Gen. option.

in the list. Whenever a question was not answered, a blank is left; if the answer was qualified the sign "?" is inserted.

A study of this table reveals fifteen affirmative answers to the first question, eight negative answers and three replies which are qualified so as to be neither yes nor no.

The second question received fourteen answers, of which eleven indicate a preference for an open option for all engineering students.

The third question was to a certain extent answered in the first but there are eight affirmative replies out of ten received.

On the whole, the weight of opinion is in favor of allowing all engineering students to elect Spanish in place of French or German. The returns as to the percentage of engineering graduates in Spanish speaking countries are incomplete, but fifteen institutions report from one to thirteen per cent. thus employed.

The average for four eastern colleges is 3.3 per cent., for eight central colleges 1.6 per cent. and for three western institutions, 8.7 per cent.

No important inferences can be drawn from the figures in this column. Many of the men thus listed are of Spanish descent and came to this country for an education. Many who would otherwise be counted have been obliged to leave Mexico and Central America on account of revolutions and other local disturbances. The figures do show, however, that comparatively few graduates of our engineering colleges are at present employed where the Spanish language is spoken.

The last two columns of the table show in a general way to what extent Spanish is at present taught in the institutions listed. The data thus afforded are subject to correction as in some instances the catalogs failed to state explicitly the status of Spanish.

The number of years given refers to the number required or offered in engineering courses and not to the total amount generally available.

By elective is meant that Spanish can be taken as an extra or in addition to German or French.

By general option is meant that it can be substituted for German or French without additional time.

Out of the total number listed, we find nine institutions where Spanish is a general option, six where it may be taken as an elective under certain restrictions, two where modern languages are electives and five where Spanish is not taught.

It may then be stated as a general proposition that in the majority of these colleges, Spanish may be taken if desired and that in one third of the number it is accepted as an equivalent for French or German.

If comparison could be made between these figures and those which obtained before 1898, it is probable that a decided change of sentiment would be evidenced thereby.

The report of the U. S. Commissioner of Education in 1888–9 showed only thirteen institutions out of a list of 101 which required or accepted Spanish in 1888. Only three of the colleges in our present list were included in the number, the universities of Michigan, Wisconsin and Texas.

It will perhaps be interesting to hear some of the comments of those who hold diverse views on this subject. Let us first hear from the conservatives:

1. "I do not think Spanish should be required of any engineering student. . . . Both the French and German have a literature which is magnificent for engineers and even a little attainment in either of them will mean a great deal to engineers throughout their lives. The engineering literature in Spanish is much less extensive. From the standpoint of language study, therefore, I think Spanish not comparable with French or German. The election of Spanish on the ground of technical desirability should justify entering it in the curriculum as an elective substitute for a technical subject."

2. "We have been offering an optional course in Spanish to the engineering students of our fourth class but we do not feel that the time has arrived when we should substitute it

for French or German, except on petition and for very good reasons."

3. "When one considers practical benefits as well as intellectual drill, I believe it is difficult to make out a good case for Spanish as compared to French and German. The absence of scientific and engineering literature in Spanish makes the utility of this language chiefly that of a mode of oral communication which is just the part the college is least able to give."

4. "I have during the past few years known personally of many men whose engagements took them into Spanish speaking countries and in no case did they report that they had any special difficulty in picking up a working knowledge of the language. On the other hand, I have known a few cases of men who have had two years work in Spanish in the schools, complaining of the small benefit derived from such study when they actually went into a Spanish speaking country."

5. "My advice to young graduates is as a rule to remain in the United States. I tell them engineers of the right sort can doubtless make a comfortable living in the United States and live their lives possibly under more auspicious circumstances than in a South American republic or in Mexico."

Quoting now from those who favor placing Spanish on a par with French and German:

6. "I have had some experience in South America and in Central America myself and I learned Spanish in a rough way in the Andes. My own opinion is that our trade would be much extended and the opportunity for engineers to be useful would be greatly improved by a large contingency of Spanish speaking engineers. . . . It has always seemed to me that we make a fetish of French and German. As a matter of fact, not one student in ten ever learns to read one of them more than passably well in an engineering school. The reason for taking them is always alleged to be that an engineer would want to read scientific papers in foreign languages. As a matter of fact, most engineers in the United States get

along very well without reading any scientific papers in foreign languages."

7. "I have believed for many years that the modern language work given in the universities and technical schools is of little practical use in engineering because it does not go far enough; because it does not give speaking and swift reading capacity; its cultural value may be very great, but as a means of increasing professional power, it occurs to me to fail usually. French and German are usually taken because the languages have a rich technical literature, while Spanish is taken for speaking use in Spanish speaking countries."

"If the object were really attained in the case of French and German, I believe it would be well to hold students to the study of one or the other, but since—as I see it—this object is not attained, I believe it would be a good thing to allow engineering students to substitute Spanish for French or German if they wish to do so."

8. "For a number of years I have enquired of our graduates, those who have had an opportunity to know something about conditions in Spanish speaking countries, and each and every one has emphasized the great desirability of Spanish for engineering students. If I had my own way about it, I would go so far as to make Spanish a requirement, either omitting entirely the German and French, or leaving them as options.

"The Germans and English in their trade relations with Mexico and South America use Spanish. We must do the same—not only that but we must study the people of these countries and learn their peculiarities and wants if we are to successfully compete for their business. This must be done in Spanish, not in German, French or English."

9. "It has been our practice for several years to allow students to take Spanish instead of French or German if they seemed to have a fairly good reason for doing so.

"For the last two or three years, we have allowed such substitution more frequently than before, it being the opinion of the faculty that the possible use of Spanish in writing and

speaking was perhaps as important as the possible use of French or German in reading.

"On the whole our experience has been satisfactory. We began the practice of allowing Spanish with some hesitation, but it appears to be the general opinion of the faculty that the privilege of election has not been abused. We are quite satisfied with the arrangement."

10. "It is possibly true that consideration has been given especially to the value of the language to the graduate in the practice of his profession, rather than to the educational value of the study of Spanish as compared with the study of either French or German. In practice, it seems somewhat general that many students have begun the study of French or German on the theory that they would use the language in connection with their scientific and engineering work in the university and after leaving the university. In general, the result is that, after all, these students never really acquire a working knowledge of either French or German. On the other hand, very many of them after graduation have found the knowledge of Spanish of great value."

Aside from the two classes of opinions just quoted, there are graded and qualified statements going to neither extreme.

Two universities report the elimination of modern languages as required subjects and another prefers making them all electives in place of some technical subject.

One institution is requiring language for admission and not teaching it in residence. Most of those who favor making Spanish an option would have this rule apply to all engineers. When exception is made, civil and mining engineers are preferred as having most use for the language.

A considerable interest in the study of Spanish on the part of the students is evidenced by the statement that at one institution sixty-five men are enrolled in this subject, at another one half of the number taking modern languages have chosen Spanish and at another more have elected Spanish than French. One deen reports nine out of ten of the engineers electing Spanish.

Considering this subject in its broader aspects, we note that at least one educator advises his students to keep away from Spanish-speaking countries and to remain in their own country. While this advice may be good for the individual, it seems a little selfish.

Most of us believe that we have in the countries south of us an opportunity and a duty which should not be neglected. We believe that the time is soon coming, if not already here, when we shall need to go outside of this country for business expansion and for engineering opportunity.

Europe is crowded now. Asia and Africa are in the hands of the European powers politically and and commercially. South America, Central America and Mexico afford natural outlets for our people. Our failure to realize this or profit by it in the past is no excuse for our continuing to do so. To say that we have but few graduates in these countries is begging the question. Our graduates are not in South America because they are not fitted by education to compete in these fields with European engineers.

I believe it is the duty of our educators to take the initiative in this matter, to call the attention of students to the opportunities which may exist and to provide suitable training for such as desire it.

Two conditions or rather two opinions are apparent from the letters quoted.

First, that French and German are not at present taught in such a way as to be of much practical value as far as foreign technical literature is concerned.

Second, that Spanish is not taught in such a way as to give students proficiency in using the language orally.

Neither of these conditions, assuming them to be true, affects the argument one way or the other. If it is desirable that German should be taught to certain groups of students, that they may use it in reading at sight German technical books, it is then the business of the university to teach it in such a thorough manner as to insure that result.

If, on the other hand, it is deemed proper and desirable

that certain other groups of students should learn to read and speak Spanish for commercial purposes, it is then the business of the university to teach Spanish in such a manner as to bring about what is desired.

There are several difficulties which have hindered the proper development of language teaching:

(*a*) Insufficient preparation on the part of secondary schools; while most colleges require on paper two years of foreign language for admission, they find it difficult if not impossible to secure this.

The result is that they are obliged to carry along more or less elementary work during the first two years and that to some extent they must neglect or omit some of the advanced work.

(*b*) The difficulty in securing time enough in a crowded engineering schedule for a subject which is regarded by many of the students and by some of the instructors as of minor importance.

(*c*) As a corollary to the preceding, a lack of appreciation on the part of the engineering college of the importance of language study in a technical course. It is believed that this difficulty is gradually becoming less.

(*d*) On the part of the language teacher, a lack of appreciation of the exact part language study is to play in the life work of an engineer.

He should realize the importance of a scientific vocabulary in French or German and practice in sight reading of technical literature; the like importance of familiarity with Spanish idioms and Spanish pronunciation for one who is to use Spanish commercially; in brief, the adaptation of the language means to some definite end which will justify the time devoted to language study.

If our engineering and our language departments could get together a little more and each learn to value the opinions and appreciate the needs of the other, it would help.

Assuming now that our German and our French and our Spanish are taught in a way which makes them severally avail-

able and useful for the practicing engineer, which shall he take and how much freedom of choice shall he be allowed?

The weight of opinion seems to favor his being allowed free choice and in about one third of the colleges listed, this is now the case. In another third, he is allowed to choose Spanish under certain restrictions.

It seems certain that if we are to take advantage of the opportunities to the south of us, we must educate a certain number of our future engineers with special reference to the demands of life in Spanish speaking countries; that we must not only offer the opportunity to study Spanish but we must show what of future employment must result from its acquirement. Recent developments in Europe make it even more desirable that we should do this thing.

Twenty-five years ago, educators looked askance on the proposed substitution of French and German for Greek and Latin; today there are few that deny the wisdom of the change To a certain extent, French and German are now the classics, the culture idols of a technical education. May it not be possible that in turn they may have to give place in a measure to other modern tongues such as Spanish, Portuguese and Italian? The signs of the times point in that direction.